EXERCISE 2. GROWTH AND EXIT OF FIRMS (continued)
(To be handed in on Nov. 9)

This exercise uses the data on exit of firms from Exercise 1. As before, 8031 observations can be found in the file ex1-1.dat in format ‘f12.0,3f10.0,3g11.0,f9.0,11g11.0’, with the variables:

- id: firm id
- year: 4 digit year, between 1986 and 1995
- sic: 4 digit sic code
- ind: 2 digit industry code
- sales: annual sales (mill. dol.)
- empty: employment (1000s)
- invest: investment (mill. dol.)
- rnd: R&D spending (mill. dol.)
- cashfl: cash flow (= retained earnings + depreciation allowances) (mill. dol.)
- kstock: knowledge stock (= accumulated R&D investment) (mill. dol.)
- netcap: net capital stock (mill. dol.)
- debt: long term debt (mill. dol.)
- q: Tobin's q
- loge: log (employment in 1000s)
- rs: ratio of R&D invest to sales
- cc: ratio of cashflow to net capital stock
- drnd: dummy: zero R&D investment
- exit: dummy: firm exits between year and year+1
- grsales: growth rate in sales (percent) between year and year+1

For this exercise, ignore the panel structure and treat the observations across years as if they were independent. A Cobb-Douglas production function,

$$ \text{sales} = A(\text{empty})^\alpha(\text{netcap})^\beta e^\varepsilon $$

is proposed in which $\varepsilon$ is assumed to have mean zero and a homoskedastic variance, and $A$ is a linear function of the ratio of the knowledge stock to the net capital stock, reflecting the impact of innovation on productivity, $A = \gamma + \delta^*(kstock)/(netcap)$.

a. Estimate the model by non-linear least squares, a GMM procedure.
b. Test the hypothesis that $\delta = 0$.
c. Do a Wald test of the hypothesis of constant returns to scale ($\alpha + \beta = 1$).
d. Do a Distance Metric test of the hypothesis of constant returns to scale.
e. Do a Lagrange Multiplier test of the hypothesis of constant returns to scale.
d. (extra credit) What is the power of the test of constant returns to scale against the alternative that $\alpha + \beta = 1.2$?